UNEDITED ROUGH DRAFT TRANSLATION

DESCRIPTION OF THE SHIP'S RADAR UNIT
EGS 392

BY: Reitmann

English Pages: 34

SOURCE: Beschreibung der Schiffsrader-Anlage, EGS 392, Teil I, Veb Funkwerk, Koepenick, pp. 1-34.

Part I

DESCRIPTION OF DEVICE

Include

~~Table of Contents~~ Page

50X1-HUM

Experimental and Test Station for Technical Ship's Equipment
(Pruefamt fuer Technische Schiffsausruestung)
of the German Democratic Republic

License award No. 6F 58.102.

The anticollision apparatus, consisting of:

1. Display device	Type Number		1421.2 A1
2. Low-voltage ~~line~~ POWER pack	"	"	1491.52 A1
3. Generator	"	"	1446.2 A1
4. Antenna	"	"	1551.7 A2

Supplier

VEB ~~Funkwerk~~ Koepenick Radio Plant (Funkwerk Koepenick)

Berlin-Koepenick

Wendenschlossstrasse 154-158

was subjected to a test under open-sea conditions. In accordance with Section 3, Paragraph 1b, of the ordinance concerning the ~~formation~~ ESTABLISHMENT of an experimental and testing station for ship's technical equipment, dated 31 March 1955 (GBl. I No. 33, Page 273), the license for use in navigation is awarded.

Special conditions for the award appear on the reverse side.

Stralsund, 9 July 1958.

Seestrasse 10

By:

(Reitmann)

Chief of Radar and Telecommunications Equipment Division

[seal]

50X1-HUM

Special Conditions ~~for~~ Awarding of License:

The supplier plant is obliged to manufacture the instruments true to the sample on the basis of the licensed unit.

The Experimental and Testing Office must be notified of modifications to the licensed equipment, and the notification must be accompanied by the appropriate information.

The License may be revoked if these conditions are not observed.

The number of the license award is to be applied clearly and permanently to each instrument.

A copy of the license award is to be included with the description to be furnished with each unit.

50X1-HUM

Function of the FGS 392 Anticollision Unit.

As an aid to piloting during low-visibility weather, the Anticollision Equipment is available for installation on seagoing vessels. ~~this equipment~~ It delivers a map-like image of the environment of the vessel from which it is possible to determine the distance and direction to obstacles such as ships, drift ice, islands, or navigational signals. ~~Here~~ the location of the vessel forms the centerpoint of the image.

Basic Operating Principles.

The circular-scanning process is accomplished by radiation of high-frequency electromagnetic waves from a pulse-keyed transmitter through a directional antenna. These waves propagate in much the same way as light waves and possess the property of being reflected ~~on~~ when striking objects (targets). Thus the range of the apparatus is limited to line-of-sight and is strongly dependent on the height at which the directional antenna is set up.

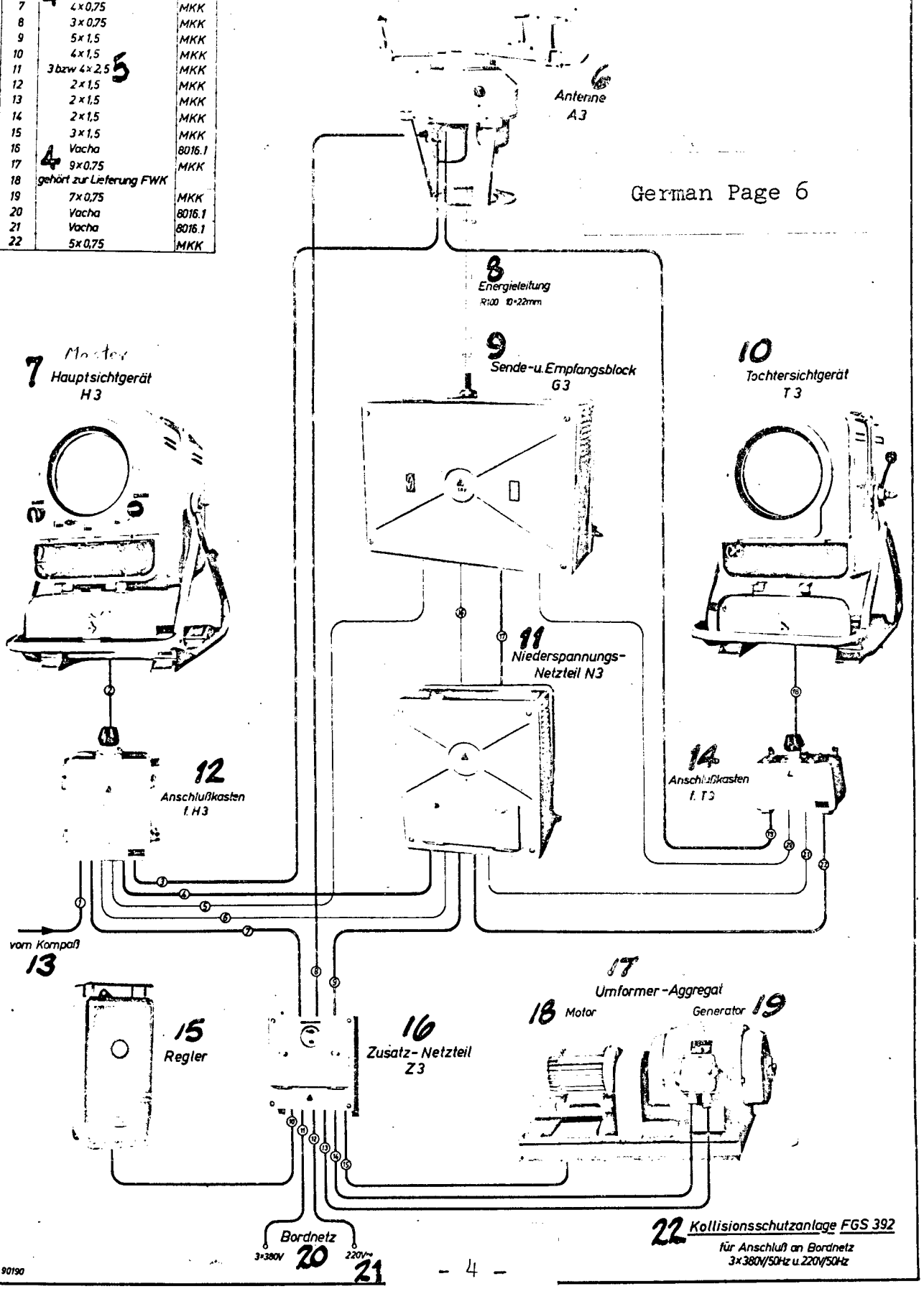
In transmission, a horn radiator beams the pulses ~~in~~coming in from the transmitter against a parabolic reflector, ~~and the latter~~ which radiates them directionally. The reflected pulses are rereceived by the same parabolic reflector, fed through the horn radiator to a receiver unit, and finally rendered visible on the image screen of an electron-beam tube.

The distance between the place of measurement and the target is established by determining the time required for an emitted pulse signal to travel the distance from the point of measurement to the target and back again. ~~Here~~ The pulse that has been radiated by the transmitter and received directly by the receiver unit is used as a control for the exact time of the reflection.

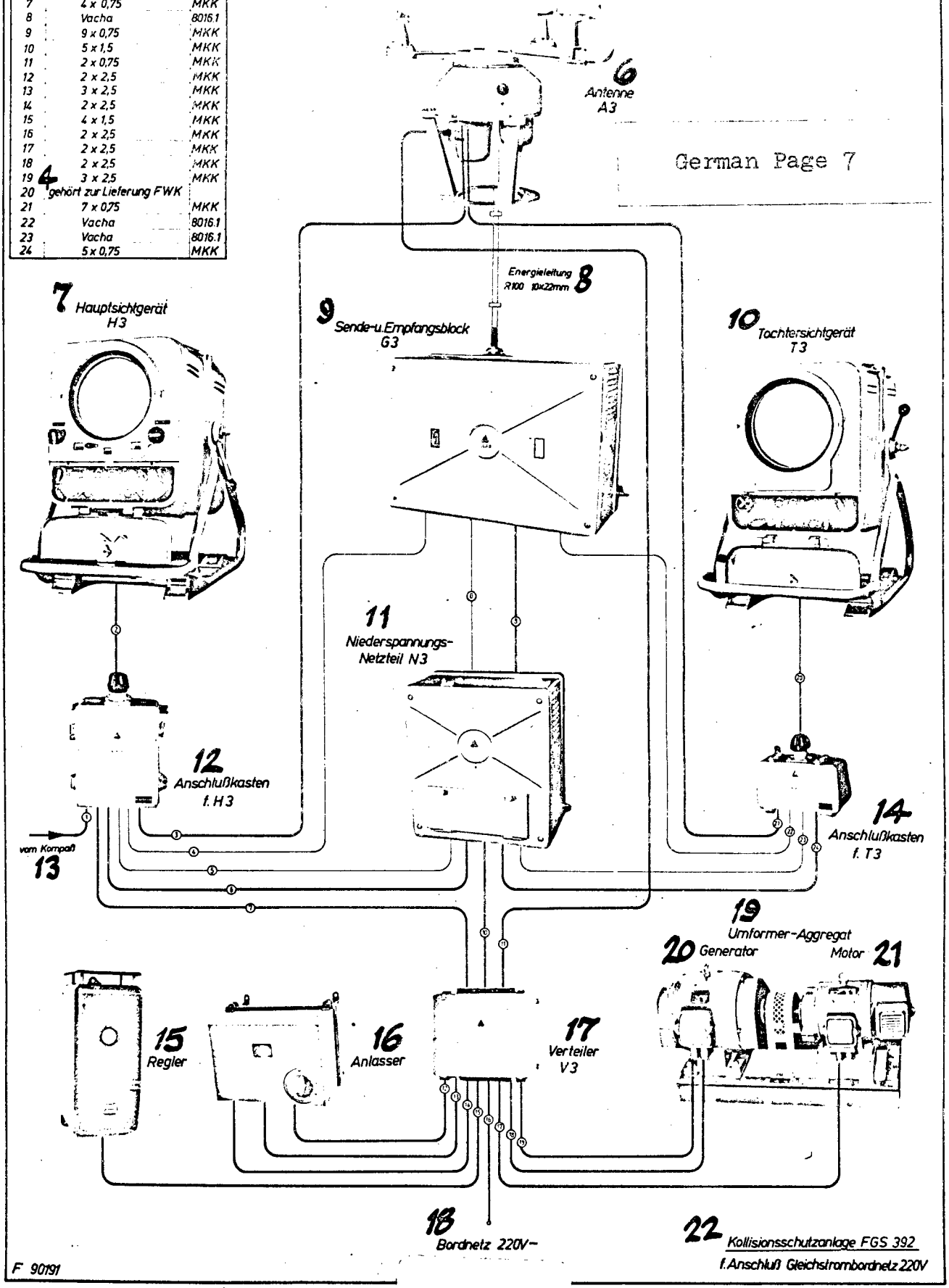
~~something miss~~ line

50X1-HUM

1 Kabel Nr	Anzahl und Querschnitte der Leitungen 2	Typ 3
1	5 × 0,75	MKK
2	gehört zur Lieferung FWK	
3	9 × 0,75	MKK
4	12 × 0,75	MKK
5	Vacha	8016.1
6	Vacha	8016.1
7	4 × 0,75	MKK
8	3 × 0,75	MKK
9	5 × 1,5	MKK
10	4 × 1,5	MKK
11	3 bzw 4 × 2,5	MKK
12	2 × 1,5	MKK
13	2 × 1,5	MKK
14	2 × 1,5	MKK
15	3 × 1,5	MKK
16	Vacha	8016.1
17	9 × 0,75	MKK
18	gehört zur Lieferung FWK	
19	7 × 0,75	MKK
20	Vacha	8016.1
21	Vacha	8016.1
22	5 × 0,75	MKK



1 Kabel Nr	2 Anzahl u Querschnitte der Leitungen	3 Typ
1	5 x 0,75	MKK
2	gehört zur Lieferung FWK	
3	9 x 0,75	MKK
4	Vacha	8016.1
5	Vacha	8016.1
6	12 x 0,75	MKK
7	4 x 0,75	MKK
8	Vacha	8016.1
9	9 x 0,75	MKK
10	5 x 1,5	MKK
11	2 x 0,75	MKK
12	2 x 2,5	MKK
13	3 x 2,5	MKK
14	2 x 2,5	MKK
15	4 x 1,5	MKK
16	2 x 2,5	MKK
17	2 x 2,5	MKK
18	2 x 2,5	MKK
19	3 x 2,5	MKK
20	gehört zur Lieferung FWK	
21	7 x 0,75	MKK
22	Vacha	8016.1
23	Vacha	8016.1
24	5 x 0,75	MKK



control for the time of emission.

Key to German page 6: 1) Cable (No.; 2) number and section of ~~conductors;~~ circuits 3) type; 4) part of ~~FWK~~ delivery; 5) 3 or 4 x 2.5; 6) antenna A3; 7) main display unit H3; 8) waveguide R100 10-22 (mm); 9) transmitter-receiver unit G3; 10) ~~daughter~~ slave display unit T3; 11) low-voltage line unit N3; 12) terminal box for H3; 13) from compass; 14) terminal box for T3; 15) regulator; 16) auxiliary line pack Z3; 17) converter unit; 18) motor; 19) generator; 20) ~~line~~ ship power; 21) 220 volt AC; 22) FGS 392 anticollision apparatus for ~~line~~ ship power supply: 3 x 380 V/50 cycles, and 220 V/50 cycles. volts, volts,

Koepenicke Radio Plant

Key to German page 7: 1) Cable (No.; 2) number and section of ~~conductors;~~ circuits 3) type; 4) part of ~~FWK~~ delivery; 5) 3 or 4 x 2.5; 6) antenna A3; 7) main display unit H3; 8) waveguide R100 10-22 (mm); 9) transmitter-receiver unit G3; 10) ~~daughter~~ slave display unit T3; 11) low-voltage line unit N3; 12) terminal box for H3; 13) from compass; 14) terminal box for T3; 15) regulator; 16) starter; 17) distributor V3; 18) ~~200~~ ship's power ~~volt DC~~ 220 volts line; 19) converter unit; 20) generator; 21) motor; 22) FGS 392 anticollision apparatus for 220-volt DC ship power line supply.

Koepenicke Radio Plant

Technical Specifications

Maximum range	24 nautical miles
Pulse power output	40 kilowatts
Resolution capability	
[near-limit*] resolution	about 60 meters
radial resolution	about 40 meters
angular resolution	about 2° degrees
Power requirement	1.5 ~~kva~~ kilovolt-amperes
Weight of unit without ~~daughter~~ slave display device and without power pack	150 (kg)
Weight of ~~daughter~~ slave display device	40 (kg)
Weight of power pack	120 (kg)

A 3 Directional Antenna

Rotary speed	20 rpm
Beaming	
horizontal	2.6° half-width
vertical	20° half-width
Minor-lobe attenuation	28 ~~db~~ decibels

*[Nachaufloesung in original; we assume that this is an error for Nahaufloesung.]

Optional drives:

~~polyphase foot-mounted~~ ROTARY FLANGE motor	220/380 volts, 50 cycles
direct-current ~~foot-mounted~~ (FLANGE) motor	220 volts

G 3 Transmitter-Receiver Unit,

1. Transmitting unit.

Frequency	9375 ~~Mc~~ megacycles (3.2 ~~cm~~ centimeters)
Keying	Pulse keying
Pulse-repetition rate	2000 cycles
Pulse duration	0.2 ~~µsec~~ microseconds
Pulse ~~power~~ output	40 ~~kw~~ kilowatts
Transmitter tube	Magnetron 730
Induction in magnet air gap	Approximately 5100 gauss
Warmup delay	Approximately 3 minutes

2. Duplexer.

Tubing cross section (inside dimensions)	10, 16 x 22, 86 (mm) with transition to 12, 6 x 28, and 5 (mm)
Inside-tube wavelength	Approximately 44.8 (mm)
Receiver blocking tube	1 B 24
Preionization current	150 ~~µa~~ micro-amperes
Transmitter blocking tube	1 B 24
Circuit	Parallel to energy lead

3. Energy conductor (antenna lead),

Waveguide	Ms [brass] 63 high-frequency rectangular waveguide after DIN 47.302 (energy conductor); nominal dimensions 22 x 10 tolerance ± 0.08
Connections	Choke flange
Sealing	Rubber gaskets and 0.1-(mm) styroflex foil
Flexible waveguide	Type 9401.2 (length 156 (mm))

4. Receiver unit,

Sensitivity	15 ~~db~~ *decibels*
Mixer stage	
Oscillator tube	Reflex klystron 723 A/B (2 K 25)
Mixer crystals	OA 513 or 1 N 23 B, complement 2 pairs
Mixing attenuation	10 ~~db~~ *decibels*
Intermediate frequency	45 ~~Mc~~ *megacycles*

5. Driver stage,

Driver pulse	Approx. 0.2 ~~usec~~ *microseconds*
Tube complement	1 ~~3~~ EY 81 1 ~~5~~ ECL 81 1 ~~5~~ SRS4452

6. Keyer stage.

Keying pulse	10 ~~to~~ 12 ~~kv~~ *kilovolts*
Tube complement	1 ~~5~~ SRS 454

7. High-voltage line unit, 12 ~~kv~~ *kilovolts*.

Rectifier complement	Selenium rectifier E 1000/375-0.01

8. Trimmer amplifier,

Tube complement	4 ~~5~~ EF 80 2 ~~5~~ EAA 91 1 ~~5~~ ECC 81

9. Sea-echo control.

Tube complement	1 ~~5~~ ECC 81

10. ~~IF~~ *Intermediate-frequency* -amplifier, C

Bandwidth	10 ~~Mc~~ *megacycles*
Sensitivity	2 ~~to~~ 2.5 ~~kv~~ kTo [illegible]
Input impedance	2 x 250 ohms
Output impedance	150 ohms
Tube complement	1 ~~5~~ ECC 84 5 ~~5~~ EF 80

Main Display Unit H 3,

Image-screen diameter,	9 ~~"~~ *inches*

Image range I	0.75 nautical miles
II	1.5 " "
III	3.0 " "
IV	6.0 " "
V	12.0 " "
VI	24.0 " "
Kipp pulse frequency	Approx. 2000 cycles
Kipp amplitude variation	Can be compensated.
Distance-measurement range	0 to 24 nautical miles
Image orientation	"Ship ahead" or "North"
Zero-point displacement	± 6 mm horizontal and vertical
Rpm of deflection coil	20 rpm, synchronous with antenna
Tube complement:	1 x ECC 81
Kipp oscillator	1 x EL 81
Intermediate-frequency final amplifier	2 x EF 80
Video amplifier	2 x EF 80 1 x EL 83
Mixing stage	1 x ECC 82 1 x ECC 81
Multivibrator	2 x EF 80 1 x ECC 82
Limiter stage	1 x ECC 81
Distance-measurement unit	2 x EF 80 1 x EAA 91 1 x ECC 81
Dead-ahead marker generator	1 x EF 80 1 x EC 92
North marker generator	1 x ECC 81 1 x EF 80
Focusing tube	1 x EL 84
Image tube	B 23 M 2 DN (afterglow screen)

T 3 ~~Daughter~~ Display Device

Image-screen diameter	9" inches

Image ranges I	0.75 nautical miles
II	1.5 " "
III	3.0 " "
IV	6.0 " "
V	12.0 " "
VI	24.0 " "
Kipp pulse frequency	2000 cycles
Kipp amplitude variation	Can be compensated
Distance-measurement range	0 ~~to~~ 24 nautical miles
Image orientation	"Dead ahead"
Zero-point displacement	± 5 mm horizontal and vertical
Rpm of deflection coil	20 rpm, synchronous with antenna

Tube complement

IF amplifier	2 x EF 80
Video amplifier	1 x EF 80
	1 x EL 83
Limiter stage	1 x ECC 81
Distance-measurement unit	2 x ECC 81
Kipp oscillator	1 x 1/2 ECF 82
	1 x EL 81
Multivibrator	1 x 1/2 ECF 82
	1 x ECF 82
Dead-ahead marker generator	1 x ECF 82
Focusing tube	1 x EL 84
Image tube	1 x B 23 M 1 DN (afterglow screen)
High-voltage ~~Line~~ power pack	2 x EY 51
~~Line~~ POWER pack	2 x EL 81
	1 x EF 80
	2 x STR 85/10

Low-Voltage Line Unit N 3.

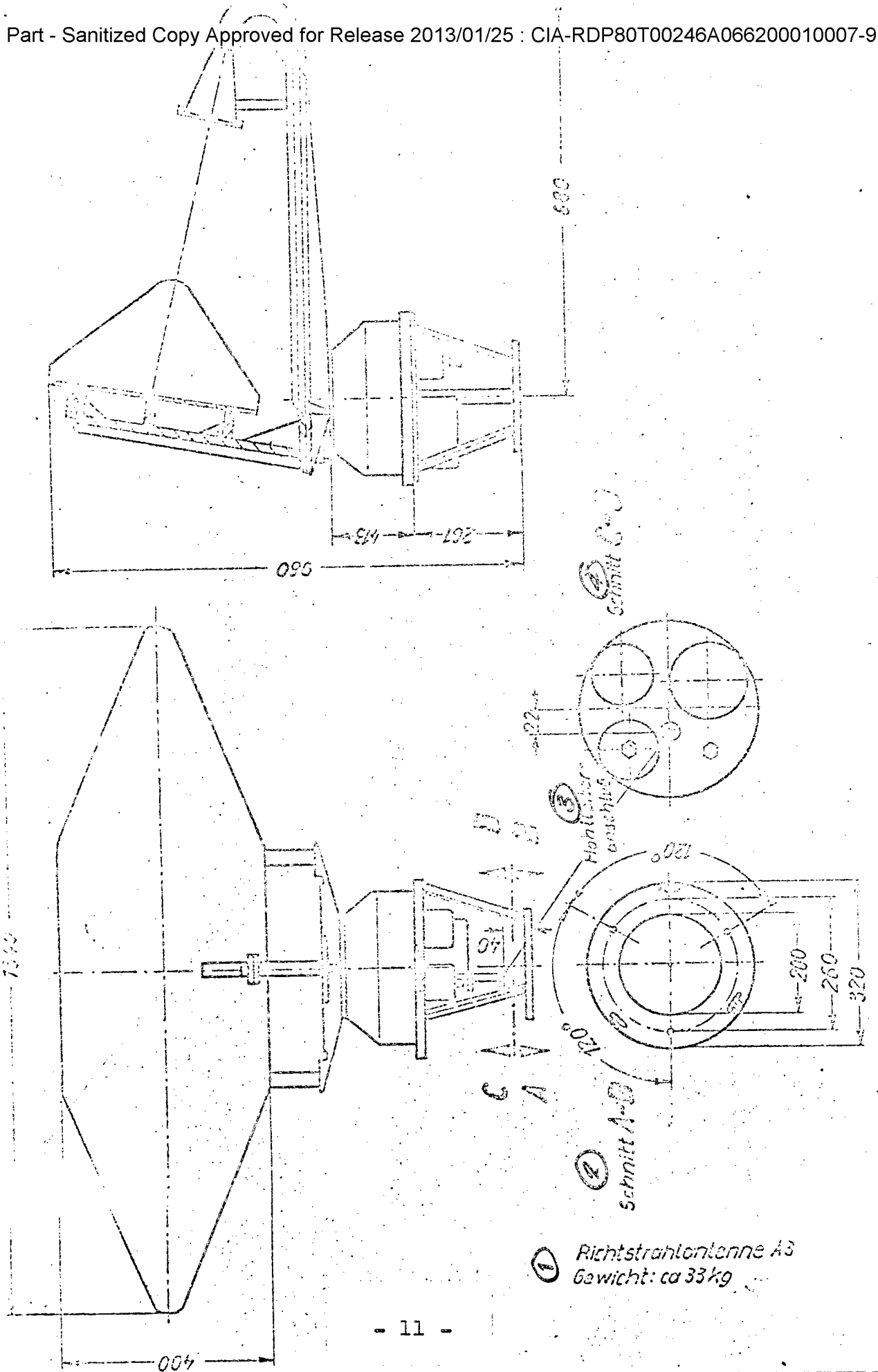
Line unit.	4 x STR 85/10
	3 x UL 84
	2 x EF 80
Master ~~oscillator~~ GENERATOR,	3 x OA 625 (Germanium diode)
	2 x ECC 81

Scope of Equipment.

The following components ~~parts~~ make up the complete FGS-392 anti-collision equipment:

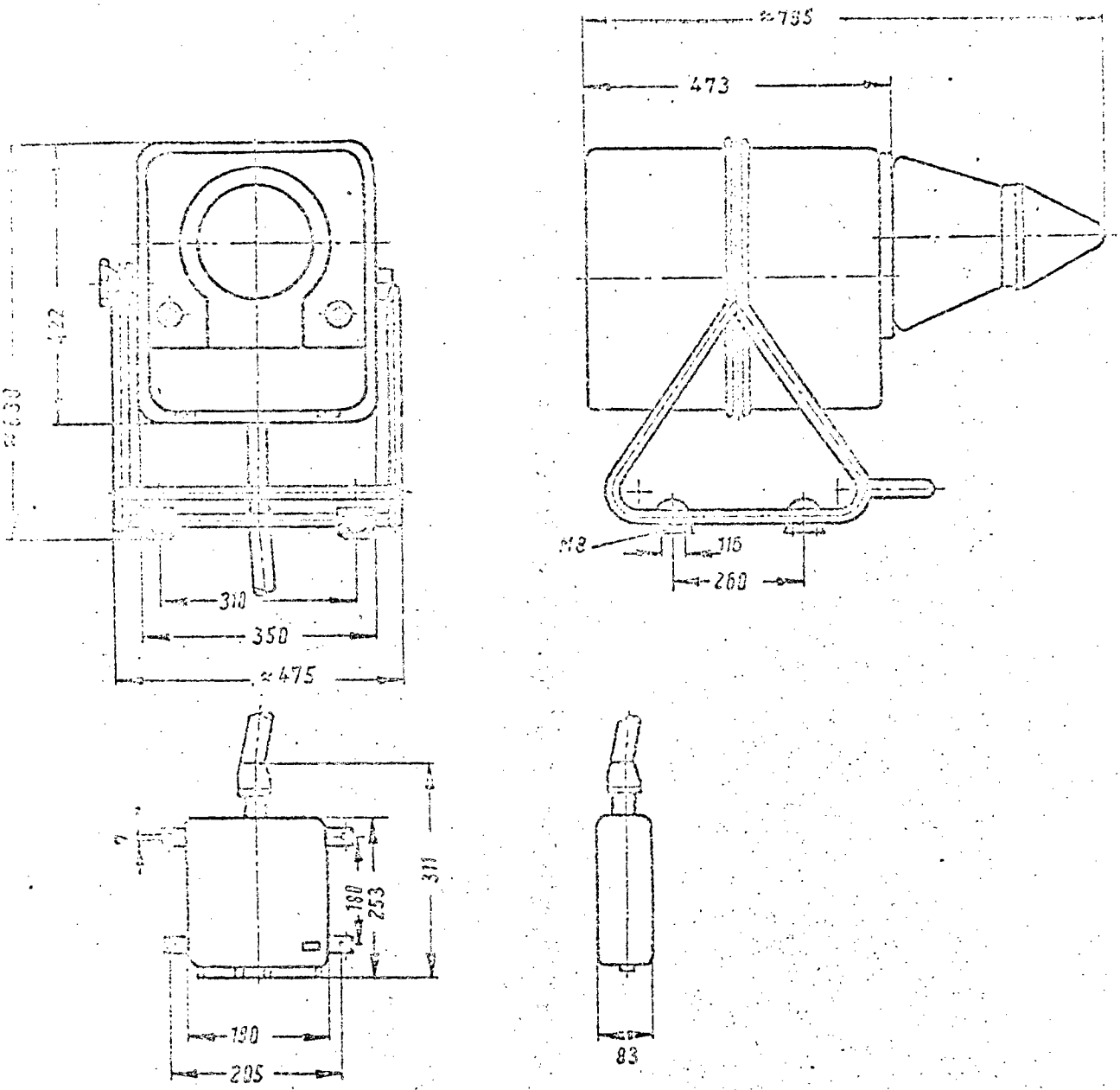
1. A 3 Directional Antenna.
2. G 3 Transmitter-Receiver Unit.
3. H 3 ~~Main~~ Display Unit.

MAIN.



① Richtstrahlantenne A3
Gewicht: ca 33 kg

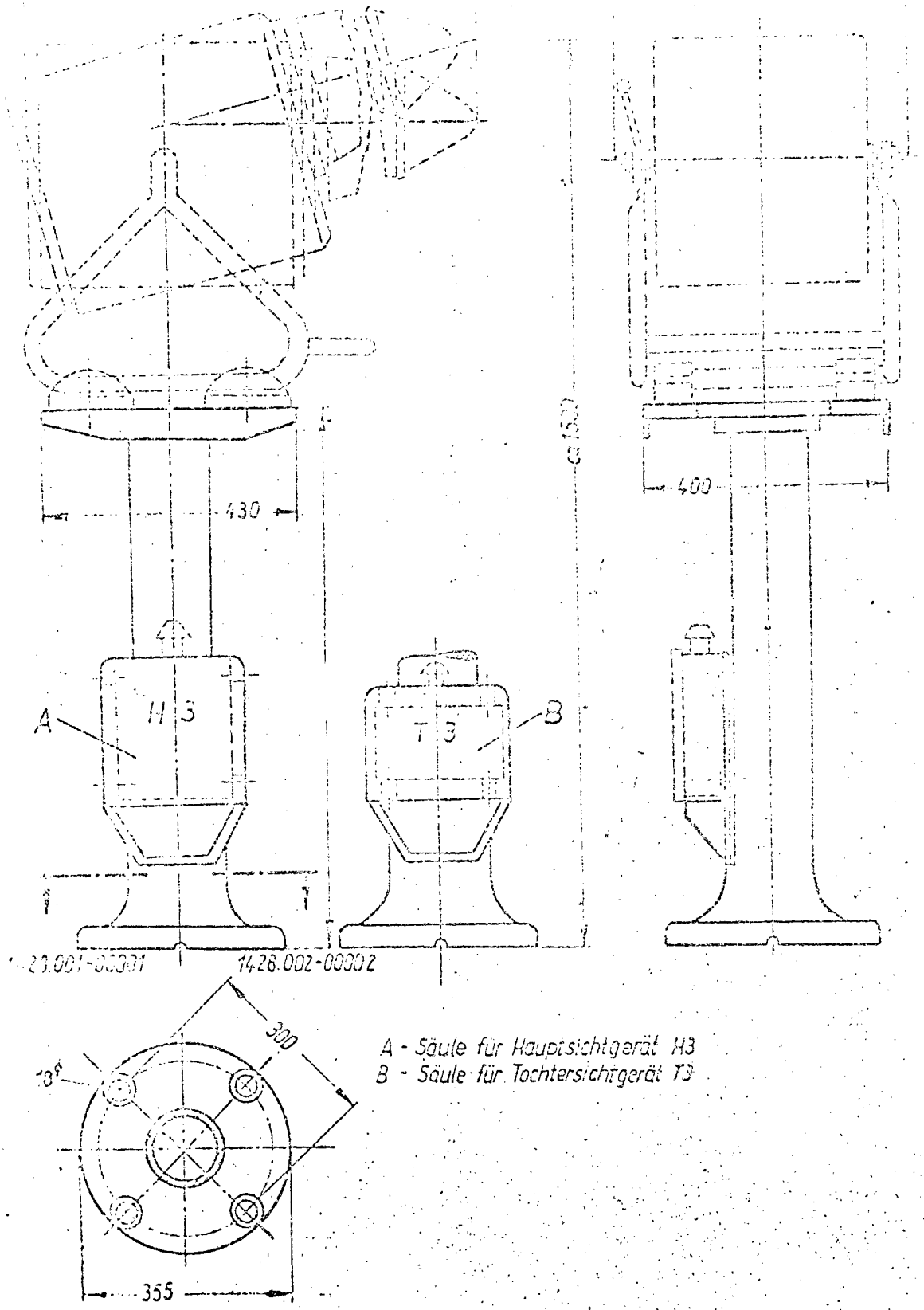
VEB | Benennung | Blatt-Nr.



(A) Hauptsichtgerät H3

Gewicht: ca 43kg

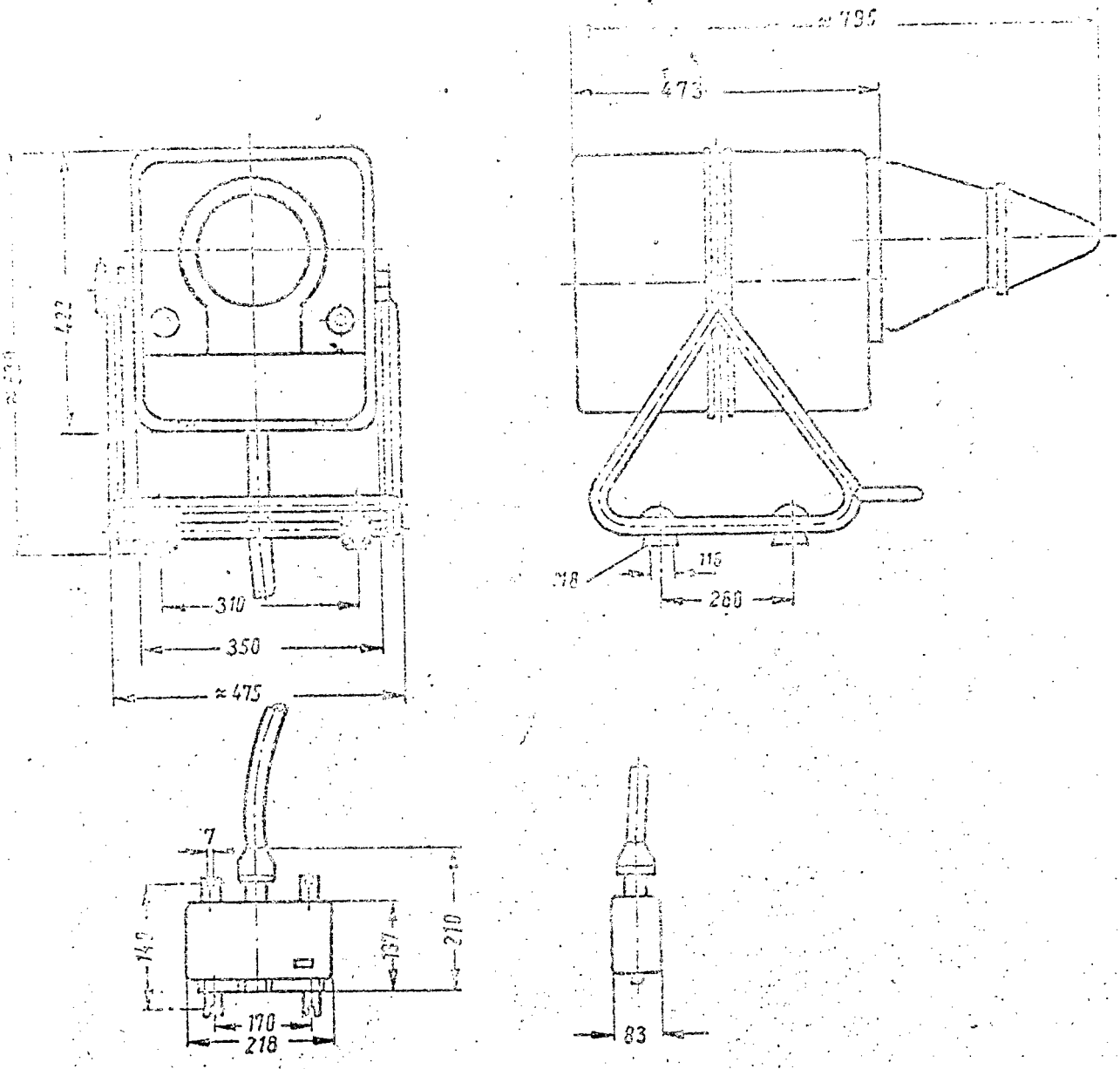
Pos	Benennung	Maßblatt	Material



A - Säule für Hauptsichtgerät H3
B - Säule für Tochtersichtgerät T3

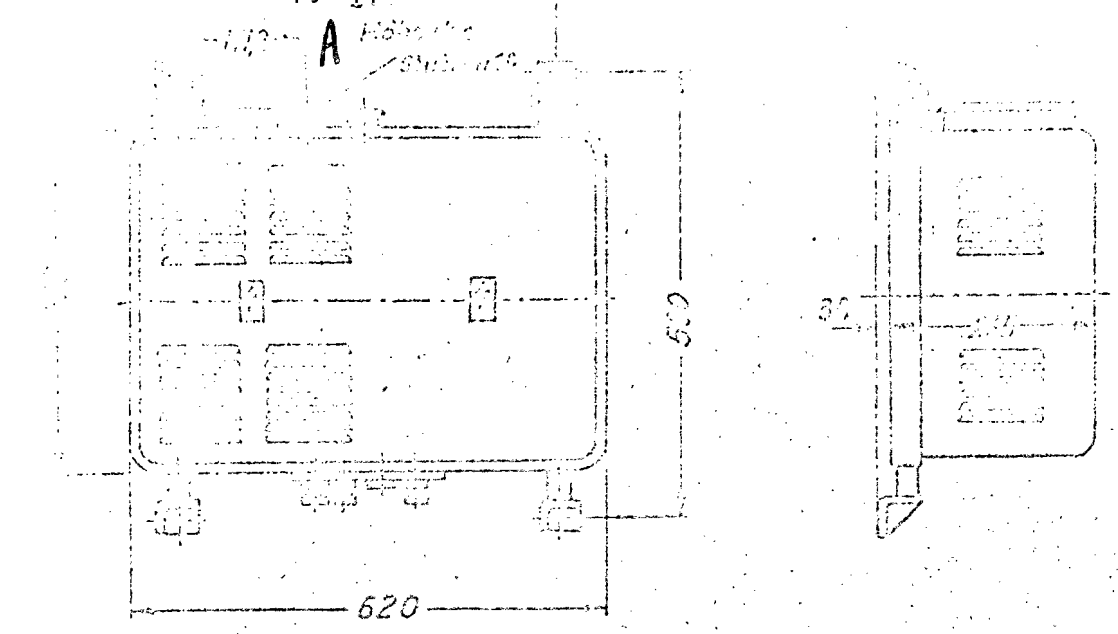
C Standsäule

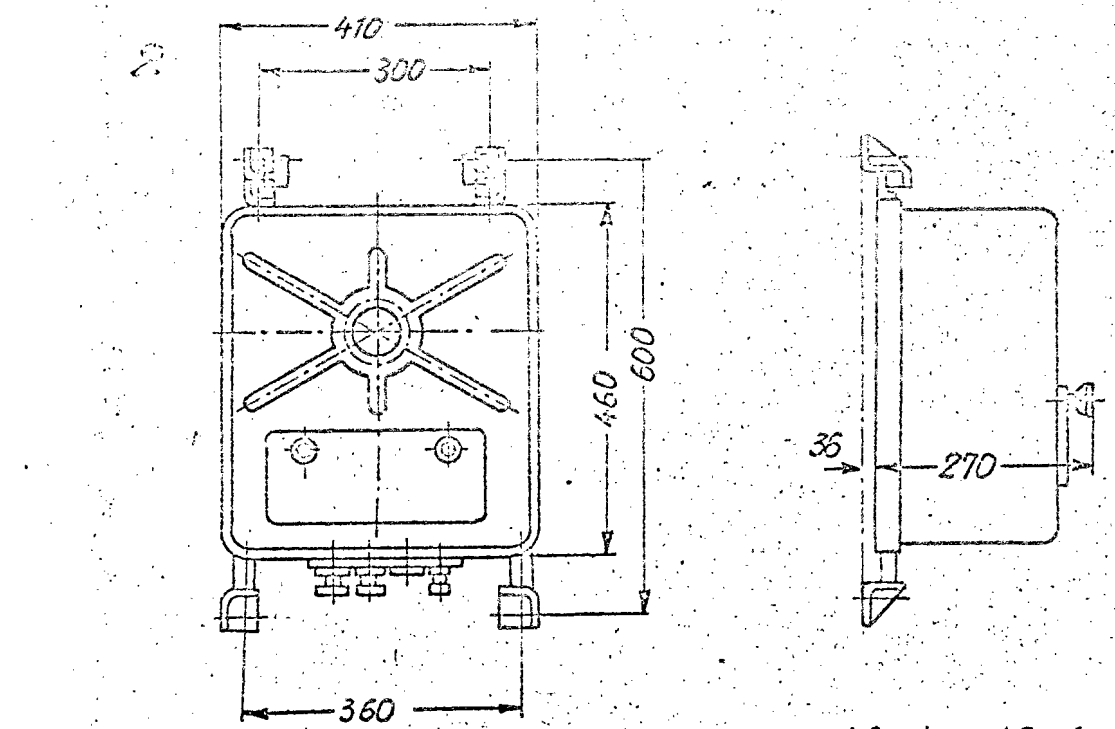
Ver.	Benennung



1) Tochtersichtgerät T3
Gewicht: ca 41 kg

VEB	Benennung	Maßblatt	Blatt-Nr.

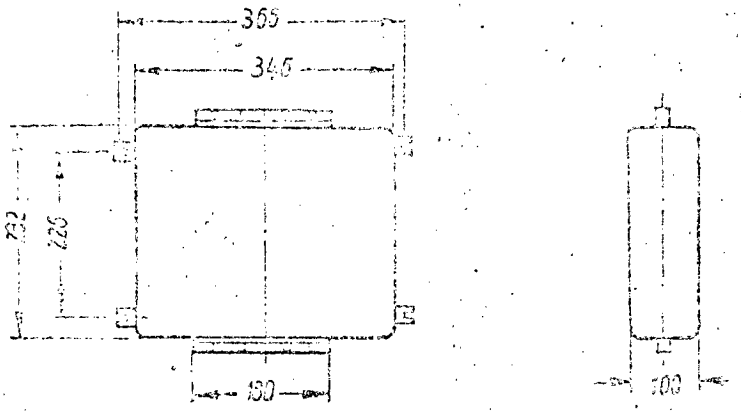




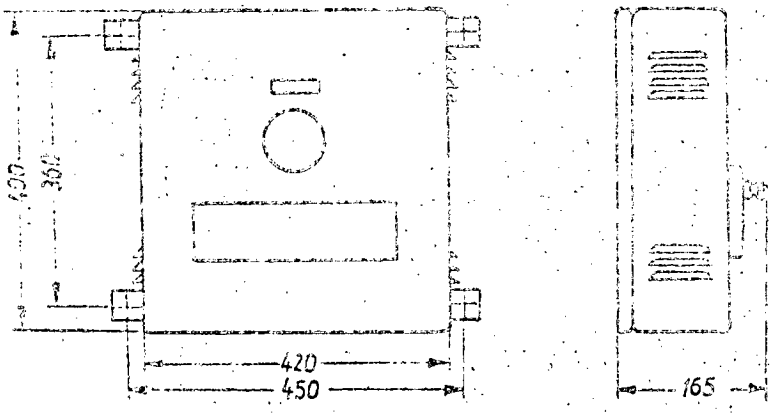
1. Sende-und Empfangsblock G3
Gewicht: ca 42kg

2. Niederspannungs-Netzteil N3
Gewicht: ca 23kg

VEB	Benennung	Kollisionsschutzanlage	Blatt-Nr.: 13

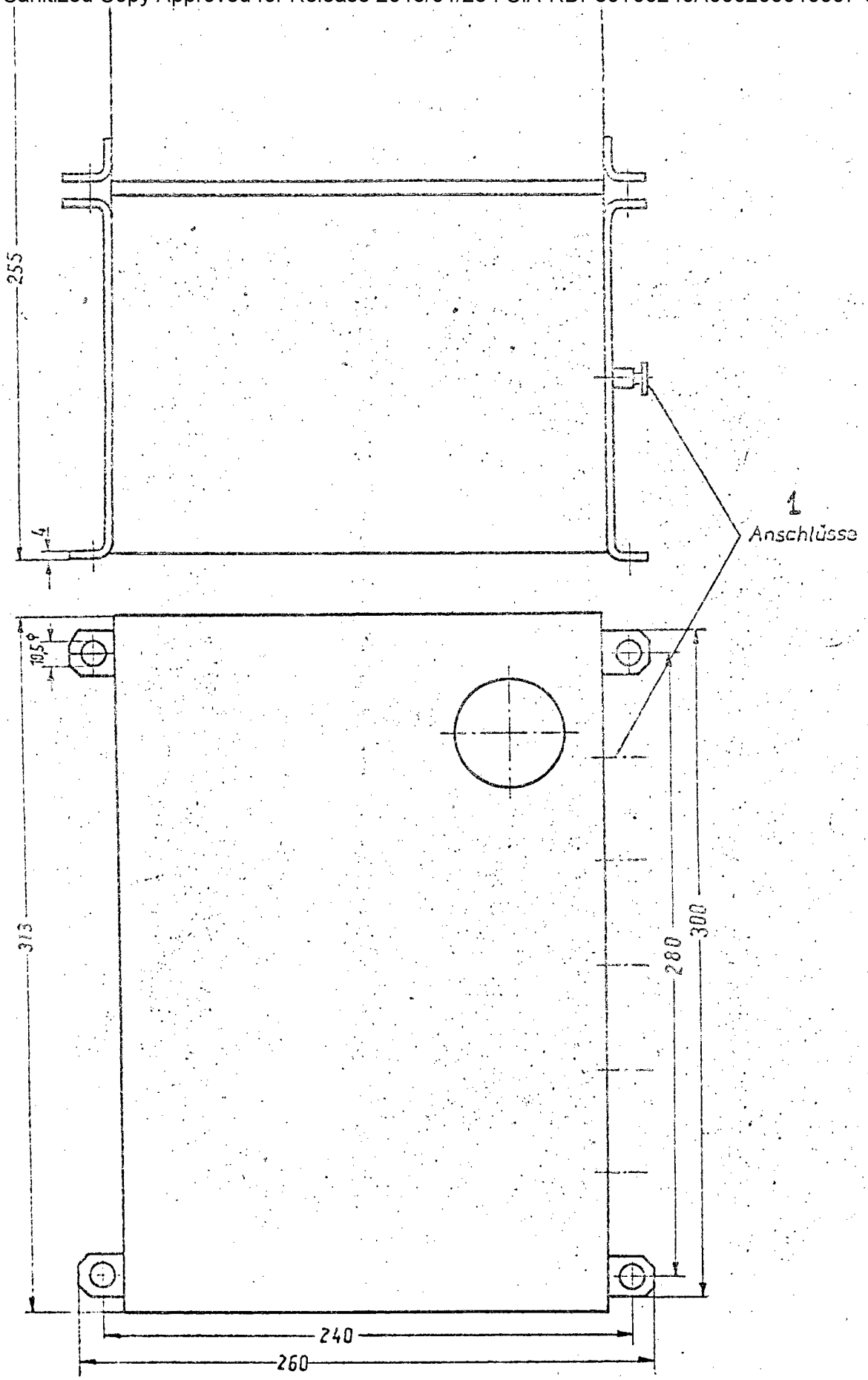


1 Verteilerkasten V3
Gewicht: ca 6kg



2 Zusatz-Netzteil Z3
Gewicht: ca 5kg

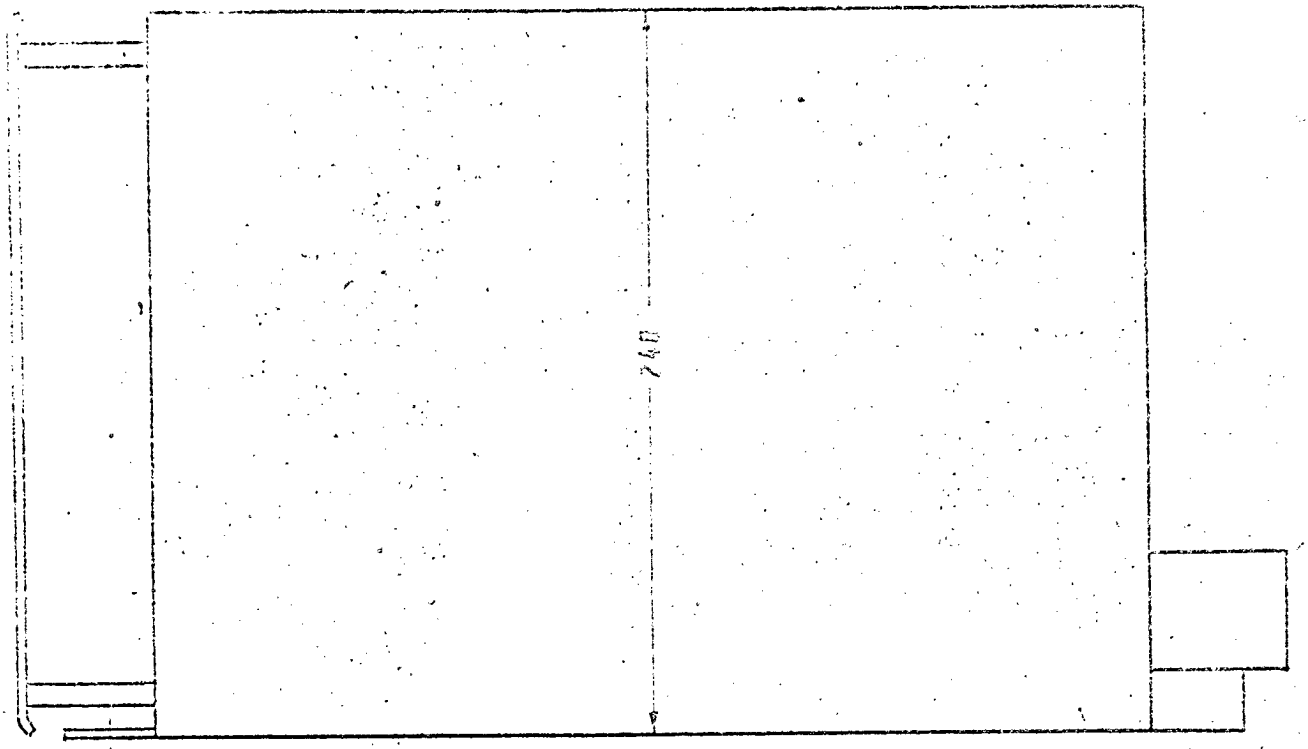
VEB	Benennung Kollisionsschutzanlage MAS 392	Blatt-Nr.: 15

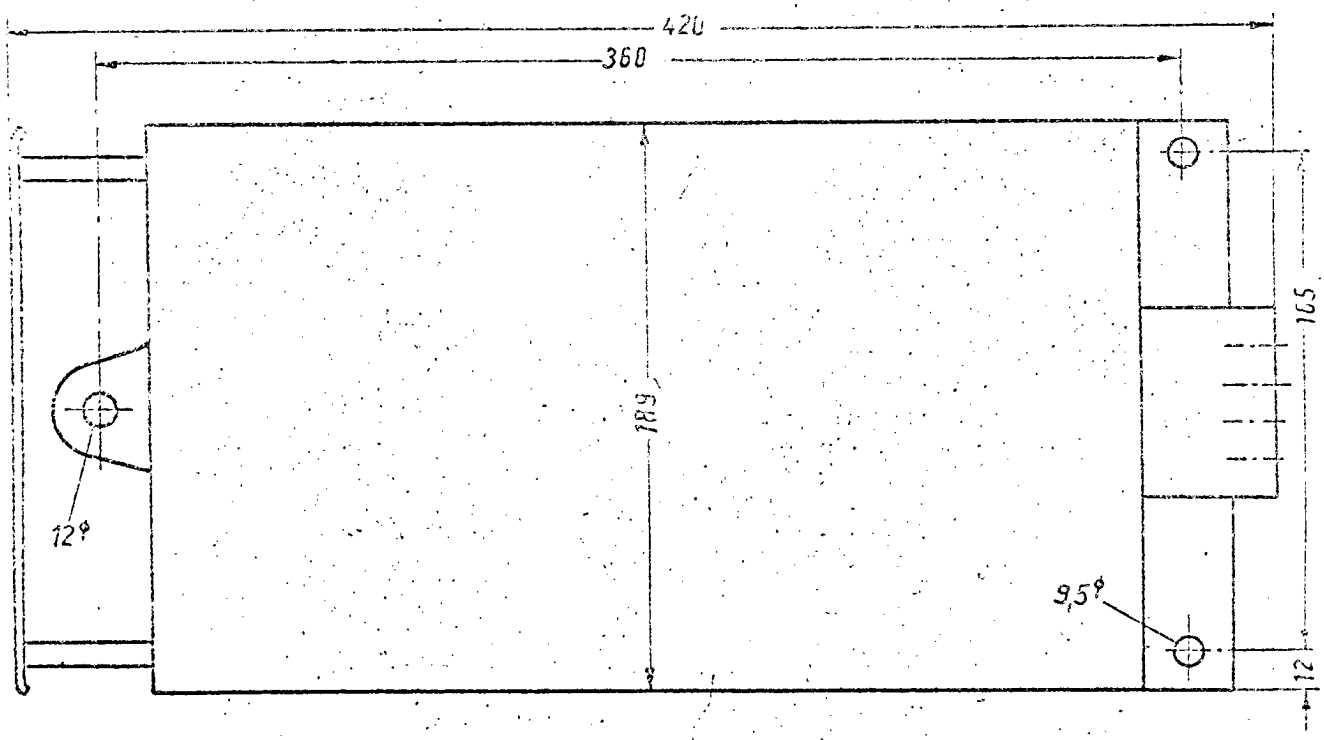


2 Marine-Gleichstrom-Selbstanlasser

3 Gewicht ca 14kg

VEB	Benennung Koll - 17 - anlage	Blatt-Nr.: 20



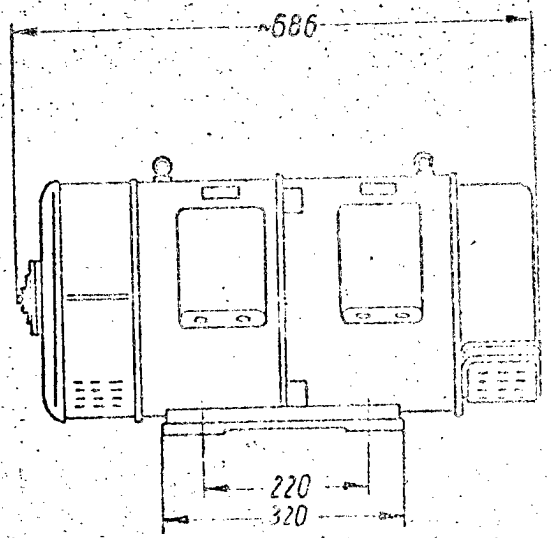


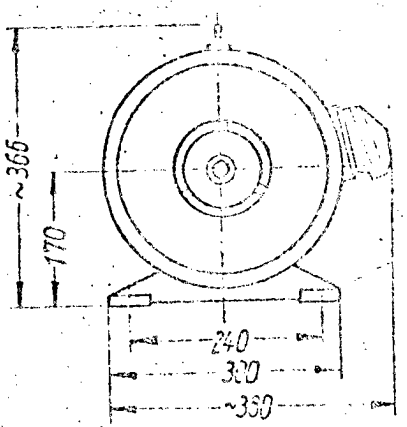
1) Kohledruckregler

2) Gewicht ca 12 kg

VEB Fahrwerk Köpenick	Benennung Kol	Beilage	Blatt-Nr.: 21

1 Umformer Aggregat 220/380V Drehstrom bzw 220V Gleichstrom





	3 Typ	4 Motor				5 Generator						6
		Nenn- 7 leistung kW	Nenn- 8 spannung V	Nenn- 9 strom A	10 Per.	7 Nenn- leistung kVA	cos φ	Nenn- 8 spannung V	Erreger- spannung V 11	Erreger- strom A 12	Per. 13	Gewicht ca. kg
14 Drehstrom-Motor	DEUB2-300B/500	1,3	220/380		50	1	0,5-1	130	220		500	125
15 Gleichstrom-Motor	GEUB2-300B/500	1,3	220			1	0,5-1	130	220		500	125

4. Terminal Box for H 3,
5. T 3 ~~Daughter~~ Display Unit,
6. Terminal Box for T 3 (SLAVE)
7. Low-Voltage ~~Line~~ Unit N 3,
8. Power Supply, power

Key to German page 14: 1) A 3-Directional Antenna, weight approximately 33 kg; 2) section through A-B; 3) waveguide attachment; 4) section C-D.

Key to German page 15: A) ~~Main~~ Master Display Device H 3, weight approximately 43 kg.

Key to German page 16: A) Column for ~~Main~~ Master Display Unit H 3; B) column for ~~Daughter~~ slave Display Unit T 3; C) mounting columns.

Key to German page 17: 1) ~~Daughter~~ slave Display Unit T 3, weight approximately 41 kg.

Key to German page 18: A) Height of connecting piece 16; 1) Transmitter-Receiver Unit G 3, weight approximately 42 kg; 2) Low-Voltage ~~Line~~ power Unit N 3, weight approximately 23 kg.

Key to German page 19: 1) Distributor Box V 3, weight approximately 6 kg; 2) Accessory ~~Line~~ power Unit Z 3, weight approximately 5 kg.

Key to German page 20: 1) Terminals; 2) Marine Direct-Current Self-Starter; 3) weight approximately 14 kg.

Key to German page 21: 1) Carbon Pressure Regulator; 2) weight approximately 12 kg.

Key to German page 22: 1) Converter set for 220/380 volts AC or 220 volts DC; 2) bore 11.5; 3) type; 4) motor; 5) generator; 6) total weight, kg; 7) rated power, ~~kw~~ kilowatts; 8) rated voltage, volts; 9) rated current, amperes; 10) cycles; 11) field voltage, volts; 12) field current, amperes; 13) cycles; 14) ~~polyphase~~ Rotary flange motor; 15) DC motor.

Construction.

A 3 Directional Antenna.

The antenna consists of the parabolic reflector, the antenna carrier, the transmission box, and the drive motor. The antenna takes the form of a parabolic-cylindrical reflector with a horn radiator set up at its focus. The aperture of the horn radiator is covered by a polystyrene plate in order to prevent penetration of moisture and foreign objects. In transmission, the horn radiator beams the pulses ~~in~~coming from the transmitter against the reflector, which reradiates them beamed in a specific direction. In reception, the echo pulses

picked up by the reflector are fed to the horn radiator and thence to the receiver.

For good circular scanning, the rotary antenna is to be set up in such a way that the radiated high-frequency energy is not detrimentally affected by interfering deck structures or reflectors.

A rectangular waveguide with the inside dimensions 10.16 by 22.86 mm is used to transmit the energy between the transmitting and receiving units. The energy link between the rotating antenna and the stationary energy conductor takes place through a pivot joint in the transmission housing.

Also enclosed in the transmission box are the angle-data pickup, which transmits the angle value to the display-unit angle-information receiver, and two cam switches, Sch 1 and Sch 2. The drive motor is flange-mounted on the outside of the transmission.

The angle sensor functions to run the antenna and the deflection coil in the display device at the same speed. The cam switch, Sch 1, serves to keep the synchronization in step. The cam switch, Sch 2, triggers marking of the dead-ahead direction on the image screen of the display unit. It is closed at the instant when the directed beam is parallel to the longitudinal axis of the vessel. To ensure that this direction indication will be accurate, the antenna reflector must be set exactly parallel to the ship's longitudinal axis when the unit is installed. The dead-ahead contact can be fine-adjusted by ± 5° from outside.

The electrical connection between the angle sensor in the antenna block, the two "synchronization" and "dead-ahead" switch contacts, and the ~~main~~ MASTER display unit is ~~effected~~ in the form of a nine-strand cable. The drive motor is fed by a special cable. When a ~~daughter~~ SLAVE display unit is used, it is connected with the antenna block

by a seven-strand cable.

The drive motor is switched on and off by the main switch on the display unit. Driving through the transmission, it turns the reflector carrier and the two switch cams at 20 rpm and the angle pickup at 360 rpm.

Transmitter-Receiver Unit (G 3)

The individual ~~design groups~~ components are mounted on a common chassis and protected against spray by a sheet-metal hood. The transmitter and receiver are separated by a shielding wall. When the hood is raised, the power voltages and high voltages are automatically switched off and the high-voltage capacitor is discharged. The keying stage, the magnetron transmitter, and the duplexer are mounted rigidly on the chassis, while the driver stage, 12-~~kv line~~ kilovolt power unit, intermediate-frequency amplifier, and trimming amplifier have their own ~~design groups~~ components. The electrical connections are made by terminal strips and ~~HF~~ high-frequency plugs. A blower provides the necessary cooling.

Main Display Unit (H 3)

This instrument is ~~executed~~ designed as a desk unit and rides in a steel-tube chassis so that the height of the image tube can be adjusted to the height of the observer. The built-in components are mounted at either side of a frame casting and ~~bonneted~~ hooded. The picture tube can be removed easily after dismounting the front ~~bonnet~~ hood and an additional retaining ring. The necessary operator's controls are at the front of the unit. Two digital counters serve to indicate the compass course and the distance indication of the adjustable distance-measurement marker. The entire unit is controlled by the range switch of the main display unit.

All cable connections terminate in a distributor box mounted at the main display unit.

T 3 ~~Daughter~~ SLAVE Display Unit.

The design closely resembles that of the ~~main~~ MASTER display unit. Unlike the latter, it possesses its own electronically controlled ~~line~~ POWER unit; ~~however,~~ but no gyrocompass connection is provided. For this reason, there is no north-marker indication. The distance-measurement unit is replaced by a fixed-distance marker generator.

N 3 Low-Voltage ~~Line~~ POWER Unit.

The ~~line~~ POWER unit is fed through the transformer with a voltage of 110 volts, 500 cycles, and supplies the G 3 transmitter-and-receiver block ~~G 3~~ as well as the ~~main~~ MASTER display unit with all of the operating voltages, ~~with the~~ except~~ion of the~~ high voltage. The transformer is set to the "readiness" condition with the range switch, Sch 9, in the display unit to supply current to the entire apparatus, the output voltage of which is supplied to the low-voltage ~~line part via~~ POWER UNIT through cables.

The ~~line~~ POWER unit delivers the following voltages to the G 3 transmitter-receiver unit ~~G 3~~ and the H 3 ~~main~~ MASTER display device ~~H 3~~:

~~plate~~ ANODE- and screen-grid voltages for the driver stage and the master ~~oscillator~~ GENERATOR, as well as klystron plate voltage (electronically stabilized), 300 volts

~~plate~~ ANODE- and screen-grid voltage for the tubes in the trimming and intermediate-frequency amplifiers. 180 (v)

negative bias for the tubes in the trimmer and intermediate-frequency amplifiers, as well as the reflector voltage for the klystron. -170 (v)

steady voltage for the image-tube deflection coils, 475 (v)

~~plate~~ ANODE- and screen-grid voltages for the tubes in the main display unit (electronically stabilized). 180 (v)

~~steady~~ DIRECT CURRENT voltage for the image-tube focusing coil, 300 (v)

negative bias for the tubes in the ~~main~~ MASTER display device, -200 (v)

DC control voltage for the relays in the ~~main~~ MASTER and ~~daughter~~ SLAVE display units, 24 (v)

Power Supply,

The generator voltage from the converter (115 volts, 500 cycles) is controlled with a tolerance of (2%) during voltage fluctuations of the ~~auxiliary line~~ SHIP'S POWER SUPPLY for operation of the equipment by a carbon pressure regulator. The entire apparatus is switched on from the main switch, Sch 9 (range switch), at the main display unit.

The power-supply system consists of the following units, in accordance with the vessel's ~~line~~ voltage:

Line Voltage 220 ~~V~~ volts DC,

Converter:
single-housing converter,
type GEUB 2-300 B/500,
supplier: Fimag.

Marine self-starter:
Type MGSA 1 (220 (v))
supplier: Switch ~~Equ~~ Instrument Plant
(VEB Schaltgeraetewerk) Dresden.

Carbon pressure regulator:
Type 56/31
(220 (v) separate excitation),
supplier:
VEB Faga Berlin

Distributor box:
Type 1499.12 A 1,
supplier:
~~VEB Funkwerk~~ Koepenick Radio Plant.

Line Voltage 3 x 220 (v) or 3 x 380 (v) Polyphase, 50 cycles

Converter:
single-housing converter,
type DEUB 2-300 B/500,
supplier: Fimag,

Carbon pressure regulator:
Type 56/31
(220 (v) separate excitation),
supplier: VEB Faga Berlin.

Auxiliary ~~line~~ power unit:
Type 1491.93 A 1,
supplier:
~~FEB Funkwerk~~ Koepenick Radio Plant,

With the exception of the ~~converter~~ TRANSFORMER, which must be spring-mounted through vibration dampers on a floor pedestal, all of the power-supply components, such as

Marine self-starter,	
Distributor box,	for DC only
Field controller	
Accessory ~~line~~ POWER unit and field regulator	for AC only

can be wall-mounted.

Function, ~~page 35~~ see schematic circuit diagram of transmitting unit.

Master ~~Oscillator~~ GENERATOR.

It produces power-supply-synchronized pulse sequences at 2000 cycles for control of the transmitter and display unit. It delivers a positive-going control pulse (adjustable for compensation of transmission lag) to the driver stage and an additional undelayed pulse for the display-unit input blocking oscillator.

Driver Stage.

The driver stage is connected as a blocking oscillator and shapes the pulse arriving from the master oscillator to a square pulse. The pulse width is determined by the delay network, Sp 1. The square pulse is put out from the tertiary winding through a capacitor to control the keying tube, and an additional pulse is taken through a voltage divider for the sea-echo controller.

Keying Stage.

The keying tube is unblocked by the square pulse arriving from the driver stage, so that the coupling capacitor, which has been charged to the plate voltage, can discharge through the magnetron. During the pause between pulses, the capacitor recharges to the plate voltage.

Magnetron Transmitter.

The magnetron builds up when the pulse voltage arriving at its cathode has reached a certain value and delivers a high-frequency pulse through the duplexer to the antenna for the duration of the keying pulse; the antenna then beams it out directionally.

Duplexer.

The duplexer is an independently operating antenna circuit that makes it possible to connect the transmitter and receiver ~~to~~ with a common antenna lead. It blocks the input to the mixer head in the intermediate-frequency amplifier for the duration of the transmission pulse, so that the sensitive mixer crystals in the mixer head will not be damaged. During reception, the antenna circuit prevents any significant part of the power received ~~energy~~ from getting to the transmitter and thus being lost to the receiver.

Only a small fraction of the transmitted-pulse ~~energy~~ power is transferred from the duplexer into the "H-aperture output" and the 70-ohm cable, Ku 1, to the mixer head of the trimmer amplifier.

The oscillator ~~energy~~ power (about 1 milliwatt per mixer crystal) is adjusted with W 14. In rechecking, the instrument of the test device must indicate about 35 ~~µa~~ micro-amperes. The test unit should be kept in the accessory box.

As a result of superposition of the pulse frequency of the magnetron transmitter and the local frequency produced in the oscillator (klystron), an intermediate frequency of 45 ~~Mc~~ megacycles appears at the mixer crystals; this is inductively coupled to the trimmer amplifier. The input pulse ~~energy~~ power is to be adjusted with W 17 in such a way that automatic control of the reflector voltage at the klystron by the trimmer amplifier is secured.

Trimmer Amplifier.

This device controls the reflector voltage of the klystron and, consequently, its ~~local~~ auxiliary frequency, in such a way that the 45-~~Mc~~ megacycle intermediate frequency is maintained independently of the temperature and voltage fluctuations that take place in the equipment. The potentiometer, W 20, which must be exposed by removal of the protective ~~bonnet~~ hood,

serves for coarse adjustment of the reflector voltage. During hand adjustment, it should be made certain that the switch, Sch 1, has been set to the position "2" (and adjustment). Fine adjustment is undertaken at the adjustable resistance, W 31, on the front plate of the display unit.

Sea-Echo Controller.

This device reduces the receiver's sensitivity for echoes from the immediate vicinity to a level at which echo pulses reflected from the highly reflective sea swells in the immediate vicinity do not appear on the image screen and clutter it. The device is cut in from the display unit using switch 4 (sea-clutter control).

Receiver Unit.

The ~~HF~~ high-frequency pulse reflected from a target is again received by the antenna and fed back through the antenna switch to the mixer-head input of the intermediate-frequency amplifier. The intermediate-frequency pulse formed there in the same way as in the mixer head of the trimmer amplifier is coupled inductively onto the intermediate-frequency amplifier. After amplification, it is fed through a 150-ohm cable to the input of the two-stage intermediate-frequency ~~final~~ TERMINAL amplifier in the display unit.

In the intermediate-frequency ~~final~~ TERMINAL amplifier, the pulse is again amplified and, after demodulation, fed through a switchable delay element to the control grid of the first video-amplifier tube. With the switch, Sch 11 (rain control), closed, the ~~delay element~~ TIME CONSTANT is shunted by the relay.

The two-stage video amplifier is choke-tuned to raise the upper cutoff frequency (10 ~~Mc~~ megacycles). Marker mixing for the distance-measurement unit and the north-mark generator takes place at the plate resistance

of the second video amplifier tube. The amplified pulses are fed to the image-tube cathode, the zero level of which is maintained at the voltage value corresponding to the background brightness by the zero-level diode, Gr 5.

The background brightness can be regulated with the resistance, W 13, and the contrast of the image by means of the resistance, W 11. The marker brightness can be adjusted at the cathode resistance, W 9, of the marker-mixer tube.

Pulsed by the positive-going control pulse of the master oscillator, the input blocking oscillator delivers a negative-going pulse to the ~~resistively~~ GALVANICALLY back-coupled multivibrator.

The multivibrator delivers a negative-going square pulse to the kipp ~~oscillator~~ GENERATOR, as well as a positive-going pulse to the Wehnelt cylinder of the image tube and the third grid of the Miller integrator in the distance-measurement device.

Thereupon a current pulse is sent from the kipp ~~oscillator~~ GENERATOR through the deflection coil of the image tube to deflect the light spot on the image screen radially from the centerpoint outward. The deflection coils rotate synchronously and in phase with the directional antenna ~~about~~ AROUND the image tube, so that the light spot is deflected at any given time in the direction corresponding to the instantaneous main beaming direction of the antenna.

The rangefinder makes it possible to determine the exact distance of a target. It feeds a ~~calibrating~~ MEASURING pulse to the marker-mixer tube after an appropriate interval of time (potentiometer W 16, range 6) after the start of each kipp pulse. These pulses become visible on the screen image as a bright concentric circle.

The dead-ahead marker ~~generator~~ INDICATOR is actuated by the "dead-ahead" contact in the antenna drive and sets the input blocking oscillator

in operation with the triggering pulse. The dead-ahead square-wave pulse that results is transmitted to the marker-mixer tube. The brightness of the dead-ahead marker can be adjusted at the resistance, W 147.

The north-mark ~~generator~~ INDICATOR is ~~controlled~~ ADJUSTED in parallel with the dead-ahead marker generator by the triggering pulse of the input blocking oscillator and actuated by the switch cam, Sch 13, of the transmission. Together with the blocking oscillator (1/2 of an ECC 81 tube), it delivers a continuous series of short pulses during only a single kipp period; these are fed to the marker-mixer tube.

The electromagnetic lens, Sp 7, functions to focus the electron beam of the image tube. The current to the lens is held constant by the focus-control tube, and regulation of the grid voltage for the focus-regulator tube and, consequently, constancy of the current to the focusing coil, are provided by the potentiometer, W 8, on the front panel.

Angle-Data Transmission System

One of the essential prerequisites for formation of a true-to-nature screen image is synchronous and cophased revolution of the directional antenna and the deflection coil. This synchronism is obtained by the use of an alternating-current angle-data transmitter. The angle-data sensor, DM 1, is coupled with the antenna in such a way that it completes 18 revolutions during one revolution of the antenna. It is electrically connected with the angle-data receiver, DM 2, in the display-device drive, and the latter rotates in synchronism with it and drives the deflection coil, Sp 6, with a transmission ratio of 18:1. In-phase running between the direction of the antenna beam and the coil deflection device is adjusted automatically by means of the relay, Rs 1, and the cam switch, Sch 15, in the drive, as well as the synchronizing contact, Sch 1, in the antenna drive. The switch cams

rotate at the same speed as the antenna and the deflection coil, Sp 6.

During in-phase synchronous running, the two cam switches are backed simultaneously. When the switch, Sch 1, in the antenna block is opened, the cam switch, Sch 15, in the display unit closes simultaneously, so that the current from the relay, Rs 1, remains cut off and the angle-data pickup, DM 1, in tne antenna block is electrically connected with the angle-data receiver, DM 22, in the display unit. On deviation from phase, on the other hand, the cam switch, Sch 15, closes if the antenna switch, Sch 1, has remained closed. The relay, Rs 1, operates, the normally closed contacts, rs 1/1 and rs 1/2, open the angle-data leads and short-circuit the disconnected windings. The angle pickup, which has been brought to a stop by the short circuit, remains stationary until the antenna switch, Sch 1, opens when the correct phase relationship between the antenna and the antenna coil has been attained; this again interrupts the circuit of the relay, Rs 1. Dropping back into its normally-closed state, the relay, Rs 1, cuts the angle-data receiver in again with its normally closed contacts, and this unit then continues to operate in synchronism with the pickup.

There is still another angle-data receiver, Dm 1, in the drive; this is controlled by the gyrocompass and automatically transmits course changes to the display unit. The angle-data pickup, Dm 1, is coupled with the deflection coil, Sp 6, when the image-orientation switch is set to the "north" position, while the course indicator (the counter) remains "on" at all times. The course-angle pickup, Dm 1, is always connected with the gyrocompass unit. Like the other ~~daughter~~ slave connections, it must be hand-set to the correct course. This fine adjustment is made by the use of a special screwdriver, which is inserted into a ~~bush~~ socket that is closed with a screw cap. This

~~bush~~ socket is situated at the front of the display unit beside the course indicator. During the adjustment, the angle-data receiver, Dm 1, is electrically disconnected from the compass unit by the switch, Sch 1, which opens at such times.

In the position marked "north" on the schematic diagram, the course-angle receiver, Dm 1, acts on the deflecting coil, Sp 6, through the differential, Di 2, turning the deflection coil, and with it the image, when the course changes. Through the mechanical connection that exists between the antenna angle-data receiver, Dm 2, and the course angle-data receiver, Dm 1, the "north" cam switch, (Sch 13), is always actuated at the moment at which the rotating antenna points north, and thus triggers the north marker (broken line). With the north orientation, the deflection coil, Sp 6, and with it the image can be brought into the correct attitude by use of the "image direction" knob. The dead-ahead marker, which always indicates the course being traveled, is triggered by the "dead-ahead" contact in the antenna drive, which is actuated at the instant at which the rotating antenna passes through the dead-ahead direction.

With the dead-ahead orientation, the dead-ahead marker is adjusted with the "image direction" control knob in such a way that it points to the top of the image screen. In this position, a locking device drops into the corresponding stop ring. The coupling, which is now operating as a slip clutch, prevents inversion of the image direction, for there is no longer any rigid coupling between the deflection coil, Sp 6, and the course angle-data receiver, Dm 1, in the dead-ahead orientation. The "image direction" knob must be pulled to operate it so that its ~~inter~~locking system is released.

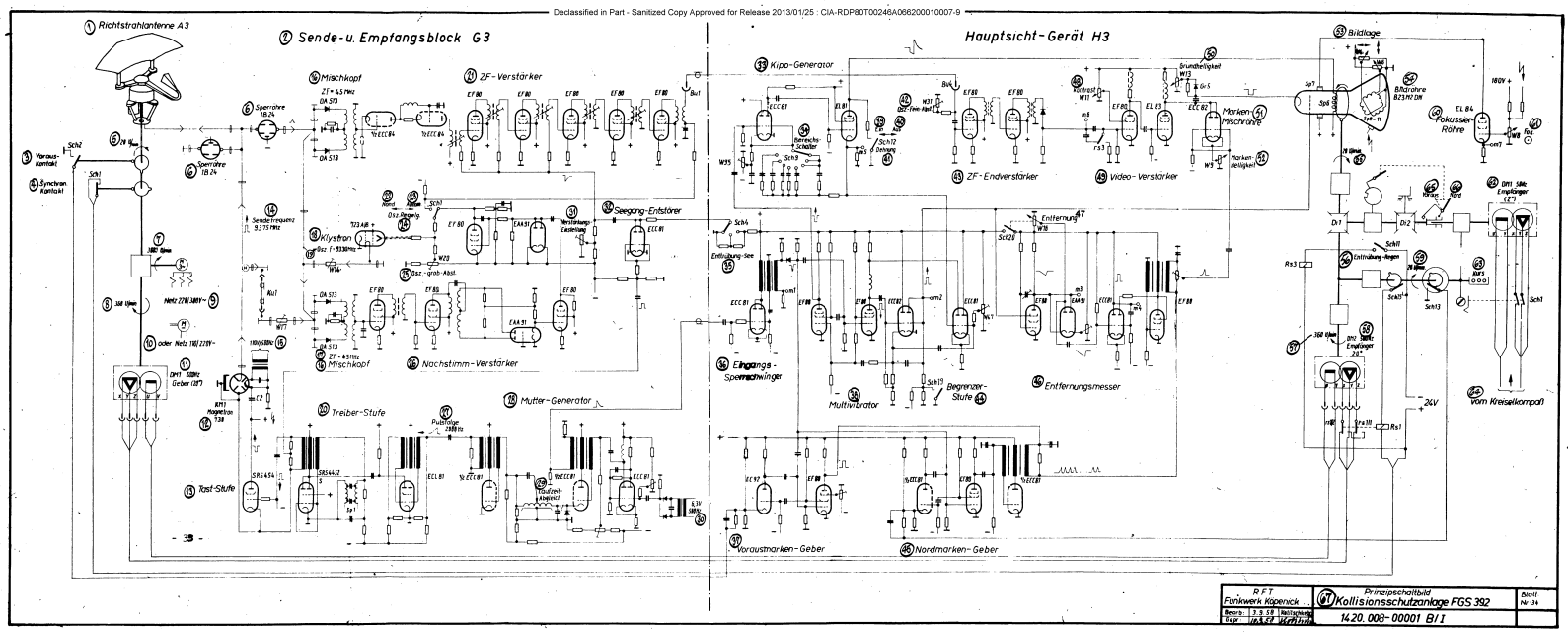
The azimuth scale is used for angle measurements during the evaluation of the screen image. It is adjusted with the "azimuth"

knob. The potentiometers, W 4 and W 6, are used to displace the zero point; they regulate the current to the correction coils, (Sp 8 ~~to~~ Sp 11). The switch, Sch 4, has the function of sea-~~echo~~ return control (sea suppression). It cuts in a positive voltage which serves to produce a control voltage for the intermediate-frequency amplifier.

The entire unit is switched on and off with the master- and range switch, Sch 9.

[Abbreviation: PTS = Pruefamt fuer technische Schiffsausruestung; ~~Test~~ Station for Technical ~~Ship~~'s Equipment]

50X1-HUM



G3

Key to German page 34 (Manuscript Page 35): 1) A 3 directional antenna; 2) transmitting and receiving unit ~~G 3~~; 3) dead-ahead contact; 4) synchronizing contact; 5) 20 rpm; 6) blocking tube, 1 B 24; 7) 3000 rpm; 8) 360 rpm; 9) 220/380-volt alternating-current line; 10) or 110/220-volt direct-current line; 11) sensor, DM 1, 500 cycles (20); 12) KM 1 magnetron 730; 13) keying stage; 14) transmitting frequency, 9375 ~~Mc~~ megacycles; 15) 110 volts/500 cycles; 16) mixer head; 17) intermediate frequency, # 45 ~~Mc~~ megacycles; 18) klystron; 19) oscillation frequency, 9330 ~~Mc~~; 20) driver stage; 21) intermediate-frequency amplifier; 22) manual; 23) automatic; 24) oscillator adjustment; 25) oscillator coarse tuning; 26) trimmer amplifier; 27) pulse repetition rate, 2000 cycles; 28) master ~~oscillator~~ generator; 29) transmission-time compensation; 30) 6.3 volts, 500 cycles; 31) gain adjustment; 32) sea-~~echo~~ return control; 33) Kipp oscillator; 34) range switch; 35) unclutter sea; 36) input blocking oscillator; 37) dead-ahead marker generator; 38) multivibrator; 39) ~~An~~; 40) ~~Dut~~; 41) ~~diffraction~~ elongation; 42) oscillator fine adjustment; 43) intermediate-frequency terminal amplifier; 44) limiter stage; 45) north-marker generator; 46) distance-measurement unit; 47) distance; 48) contrast; 49) video amplifier; 50) background brightness; 51) marker-mixer tube; 52) marker brightness; 53) image position; 54) image tube, B 23 M 2 DN; 55) 20 rpm; 56) rain-~~echo~~ return control; 57) 360 rpm; 58) DM 2, 500-cycle receiver, 20; 59) 20 rpm; 60) focusing tube; 61) focus; 62) DM 1, 50-cycle receiver (20); 63) course; 64) from gyrocompass; 65) dead-ahead; 66) north; 67) Schematic circuit diagram of FGS 392 Anticollision Apparatus.

megacycles

Title of drawing

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